



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



The mediating role of sun exposure on the association between sedentary behavior and sleep quality: A population-based cross-sectional study

Keywords:

Sleep disorders
Sedentary lifestyle
Physical activity
Public health
Sunlight

Dear Editor,

Sedentary behavior (SB) combined with less sun exposure can affect circadian rhythm changes and impair sleep [1]. Although necessary, confinement measures to mitigate the covid-19 pandemic can negatively affect health behaviors, such as reduced sun-exposure, increased SB, and poor sleep quality [2]. Several studies have reported that SB is associated with poor sleep quality during the covid-19 pandemic [3,4], and that reduced sun-exposure may mediate this association. However, there is a lack of population-based studies that evaluate the mediating role of sun-exposure on the relationship between SB and sleep quality during the pandemic. Thus, this study evaluated the repercussions between SB and sleep, mediated by reduce sun-exposure during the pandemic.

We present data from a population-based survey by stratified, multistage probability cluster sampling of 1629 adults (October–December-2020) in Iron Quadrangle region, Brazil [5]. The exposure was SB (≥ 9 hours/day of total sitting-time). The outcome was poor sleep quality (PSQI >5). The mediator was sun-exposure, classified as “insufficient” (<30 min/day). Mediation-analysis was performed with Karlson-Holm-Breen (KHB) method [6], and we constructed a contrasted directed acyclic graph (DAG) to guide the analysis.

Most individuals had poor sleep quality (52.5%; 95% CI:48.6–56.4), and 15.2% had SB of ≥ 9 hours/day (95% CI:12.1–18.9). In multivariate analysis, adjusted by sex, age, schooling, income, body mass index and comorbidities, SB was associated with poor sleep quality (β -total-effect:0.60; 95% CI:0.09–1.09). In mediation-analysis, we found that 16.7% of the association was mediated by insufficient sunlight exposure (β -indirect-effect:0.10; 95%CI:0.01–0.19).

Therefore, high SB was associated with poor sleep quality and insufficient sunlight exposure explains part of the association. Light is the strongest zeitgeber for the circadian system, and keeps most biological rhythms internally synchronized, especially sleep [7]. During the day, outdoor light intensities can range according to climatic and geographical conditions; in outdoor areas, the average lux can be between 1000 and 25,000 lux. In contrast, standard office lighting offers only 50–500 lux indoors [8]. For this reason, the daytime sunlight source profoundly influences the circadian cycle and is indispensable for a good night's sleep [7]. Our results demonstrate the importance of monitoring the SB and sunlight exposure of the population, especially during events or situations where people may be under social restriction.

Declaration of competing interest

Authors declare none.

References

- [1] Yang Y, Shin JC, Li D, An R. Sedentary behavior and sleep problems: a systematic review and meta-analysis. *Int J Behav Med* 2017;24(4):481–92. <https://doi.org/10.1007/s12529-016-9609-0>.
- [2] Bates LC, Zie G, Stanford K, et al. COVID-19 impact on behaviors across the 24-hour sedentary behavior, and sleep. *Children* 2020;7(138).
- [3] Runacres A, Mackintosh KA, Knight RL, Sheeran L, Thatcher R, Shelley J, McNarry MA. Impact of the COVID-19 pandemic on sedentary time and behaviour in children and adults: a systematic review and meta-analysis. *Int J Environ Res Publ Health* 2021;18(21):11286. <https://doi.org/10.3390/ijerph182111286>.
- [4] Limongi F, Siviero P, Trevisan C, Noale M, Catalani F, Ceolin C, Conti S, di Rosa E, Perdixi E, Remelli F, Prinelli F, Maggi S. Changes in sleep quality and sleep disturbances in the general population from before to during the COVID-19 lockdown: a systematic review and meta-analysis. *Front Psychiatr* 2023;14(April):1166815. <https://doi.org/10.3389/fpsy.2023.1166815>.
- [5] Menezes Júnior LAA de, Lourenção LG, Andrade AC de S, Carraro JCC, Machado-Coelho GLL, Meireles AL. Determinants of poor sleep quality in adults during the coronavirus disease pandemic: COVID-Inconfidentes, a population-based study. *Sao Paulo Med J* 2022. <https://doi.org/10.1590/1516-3180.2022.0139.r1.19082022>. Published online October 28.
- [6] Karlson KB, Holm A, Breen R. Comparing regression coefficients between same-sample nested models using logit and probit: a new method. *Socio Methodol* 2012;42(1):286–313.
- [7] Blume C, Garbaza C, Spitschan M. Effects of light on human circadian rhythms, sleep and mood. *Somnologie* 2019;23(3):147–56. <https://doi.org/10.1007/s11818-019-00215-x>.

- [8] Tähkämö L, Partonen T, Pesonen AK. Systematic review of light exposure impact on human circadian rhythm. *Chronobiol Int* 2019;36(2):151–70. <https://doi.org/10.1080/07420528.2018.1527773>.

Luiz Antônio Alves de Menezes-Júnior, Samara Silva de Moura
Nutrition School, Federal University of Ouro Preto, Ouro Preto, Minas
Gerais, Brazil

E-mail addresses: luiz.menezes@aluno.ufop.edu.br (L.A.A. Menezes-Júnior), samara.moura@aluno.ufop.edu.br (S.S. Moura).

Amanda Gonçalves Miranda
Belo Horizonte University Center, Belo Horizonte, Minas Gerais, Brazil
E-mail address: amanda.miranda@aluno.ufop.edu.br.

Amanda Cristina de Souza Andrade
Department of Public Health, Federal University of Mato Grosso,
Cuiabá, Mato Grosso, Brazil

George Luiz Lins Machado-Coelho
Federal University of Minas Gerais, Ouro Preto, Minas Gerais, Brazil
E-mail address: gmcoelho@ufop.edu.br.

Adriana Lúcia Meireles*
Federal University of Ouro Preto, Ouro Preto, Minas Gerais, Brazil

* Corresponding author. Federal University of Ouro Preto, R. Diogo de Vasconcelos, 122, Ouro Preto, MG, Brazil.
E-mail addresses: adriana.meireles@ufop.edu.br, covid.inconfidentes.ppgsn@ufop.edu.br (A.L. Meireles).

26 January 2023
Available online 9 June 2023